Effect of Environmental Instability on the Sensitivity of Convection to the Rimed Ice Species

Research Highlight

Despite a number of studies dedicated to understanding the sensitivity of deep convection simulations to the properties of the rimed ice species in microphysics schemes, no consensus has been reached on the nature of the impact. Considering the need for improved quantitative precipitation forecasts, it is crucial that the cloud modeling community better understand the reasons for the differing conclusions among previous studies and know the relevance of these sensitivities for the numerical weather prediction.

Research conducted at Brookhaven National Laboratory examined the role of environmental conditions and storm type on the sensitivity of precipitation simulations to the nature of the rimed ice species used (graupel or hail). Idealized three-dimensional simulations of supercells and squall lines were performed in varying thermodynamic environments.

This study shows that graupel-containing and hail-containing storms produce domain-averaged surface precipitation that is more similar than many earlier studies suggest if the simulation period is of sufficient length (> 2 hrs). Graupel is lofted to higher altitudes and has a longer residence time aloft than hail, which causes a delayed precipitation onset for graupel storms compared to the hail storms; however, most of this graupel eventually reaches the surface and the surface precipitation rates of hail- and graupel-containing storms converge. The magnitude of this sensitivity depends on environmental conditions, such as convective available potential energy (CAPE). Simulations of storms in large-CAPE environments (typical of storms in the mid-western U.S.) are more sensitive than their low-CAPE counterparts (typical of storms in Europe) to the nature of the rimed ice species in terms of domain-average surface precipitation. For equal amounts of CAPE, supercells are more sensitive than squall lines to the nature of the rimed ice species in terms of spatial precipitation distribution and peak precipitation.

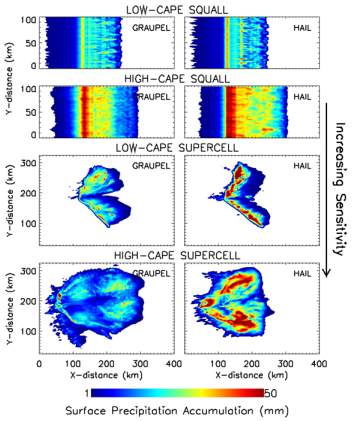

Figure 1: Spatial Distribution of the 5-hr accumulated surface precipitation for simulations that contain graupel (left) and hail (right). Squall lines are shown in the top 4 panels and supercells in the bottom 4 panels.

Reference(s)

Van Weverberg K. 2013. "Impact of environmental instability on convective precipitation uncertainty associated with the nature of the rimed ice species in a bulk microphysics scheme." Monthly Weather Review, , doi:10.1175/MWR-D-13-00036.1. ACCEPTED.

Contributors

Kwinten Van Weverberg, *Brookhaven National Laboratory*

Working Group(s)

Cloud Life Cycle